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Effects of supplemental feed and fertilizer on growth and survival of *Macrobrachium rosenbergii* (de Man) post larvae in pond nursery system

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Abstract
The study was conducted to compare the performance of different nursing practices of giant freshwater prawn (*Macrobrachium rosenbergii*) post-larvae (PL). Three treatments such as only fertilizers (T_1), fertilizers with 5% supplementary feed (local feed) (T_2), and 10% commercial feed (T_3) were applied in the nursing system of prawn PLs in earthen pond. An earthen pond (315 m^2) was divided into nine equal small ponds by fine meshed nylon nets. Feeds were used once daily on a tray placed near the pond bottom. There was a significant difference ($p<0.05$) in some water quality parameters like pH and total alkalinity, but all measured water quality parameters *viz.* water temperature, transparency, dissolved oxygen and ammonia-nitrogen were within the acceptable range for nursing of prawn PL. The results showed that the mean final lengths of prawn post-larvae were 6.3±0.07 cm, 7.12±0.22 cm and 8.17±0.16 cm in T_1, T_2 and T_3, respectively. There were significant difference ($p<0.05$) in mean final length of prawn PL among the treatments. Significantly higher ($p<0.05$) average daily weight gain was observed in T_3 (0.071±0.007 g) than in T_2 (0.052±0.006 g) and T_1 (0.031±0.002 g). The specific growth rate (SGR) of T_3 (8.81±0.26) was found significantly higher ($p<0.05$) than T_2 (8.35± 0.22) and T_1 (7.42±0.11). Survival rate (%) was also significantly higher ($p<0.05$) in T_3 (66.24±1.58) than in T_2 (60.52±1.64) and T_1 (53.86±2.71). Therefore, it may be concluded that the growth and survival in prawn nursery was better in commercial feed than only fertilizers and fertilizers with local feeds.

Key words: *M. rosenbergii*, Post-larvae, Nursing, Commercial feed

Introduction

Among the wide array of prawn species available in Bangladesh, the long legged giant freshwater prawn, *Macrobrachium rosenbergii* with the popular Bangla name "Golda chingri" contributes to the major share of the exported prawns. This species remains by far the major subject of cultivation because of its global market evolved during the 1990s and is currently being further developed. Despite the immense potential,

expansion of prawn farming in this country is limited by several constraints. The most important ones are: (i) insufficient supply of quality prawn seeds in both coastal and inland areas, (ii) unpredictable initial mortality of prawn in grow-out ponds due not to stocking with nursed juveniles, (iii) lack of prawn grow-out management technologies appropriate for local conditions, and (iv) lack of appropriate research and extension works in technology development, synthesis and dissemination.

Though freshwater prawn grow, mature, fertilize, even hatch and about 90% of global prawn production is done in freshwater environment, their larvae neither can survive nor grow up to post-larval stage without brackish water. Therefore, prawn culture in this country is being developed in and around the coastal areas, depending on naturally collected seeds. Though only few prawn hatcheries are being operated, their production rate is not consistent and far below the country's requirement. This means the pressure on natural resources will be growing, resulting in shortages of natural seed supply. Therefore, proper management of freshwater prawn nursery has utmost importance, because availability of water and culture period restricts the grow-out management in Bangladesh.

From the above discussion, we can say that, the prawn seed supply is insufficient compared to the requirements of our country. So if the seeds are not nursed properly, mass mortality of prawn PL may occur and the farmers may loose their interests to prawn culture and if that happens, it will ultimately affect our national economy. At this initial stage of prawn nursery, the farmers must need adequate information on a proper nursing system to best serve their purpose. With this point of view, the present research has been designed primarily to understand some practical information on different feeding options including feeding on particular commercial feed.

Materials and methods

The study was carried out in a rectangular earthen pond of 315 m^2 at Freshwater Station of the Bangladesh Fisheries Research Institute, Mymensingh for 60 days from July to September. The large pond was divided into nine equal small pond of 35 m^2 each by fine meshed nylon net. There were three replications for each of the three treatments *viz.* only fertilizers (T_1), fertilizers with 5% supplementary feed (local feed) (T_2) and 10% commercial feed (T_3). Local feed was prepared by using the local ingredients such as rice bran 70% and mustard oil cake 30%. Saudi-Bangla shrimp feed was selected as commercial feed for this experiment.

Complete removal of all undesirable fish, insect and other aquatic organisms were done by drying the ponds. After one week of drying, lime was applied at a rate of 1kg 40/m^2. After 3 days of liming, the ponds were filled with deep tube-well water. All the ponds were equally fertilized with urea and triple super phosphate (TSP) at the rate of 100 g 40/m^2 each and cowdung at the rate of 10 kg 40/m^2. The water depth was maintained to a maximum of 1m using fine meshed PVC over flow pipe on the bank fixed at 1m above the pond bottom. Leaves of coconut tree were used in each pond to

provide shelter for prawn post-larvae. The PL of *M. rosenbergii* were collected from the hatchery of BFRI. The ponds were stocked with prawn PL having average weight 0.022±0.00 g, 0.021± 0.00 g and 0.022±0.002 g in treatment T_1, T_2 and T_3, respectively and average length 0.89±0.01 cm, 0.88±0.01 cm and 0.11±0.07 cm in treatment T_1, T_2 and T_3, respectively. The stocking density of prawn PL was 20/m^2. Cowdung, urea and triple super phosphate (TSP) were applied weekly throughout the experimental period at a rate of 3kg 40m^2, 75 g40 m^2 and 50 g/40 m^2, respectively. Feeds were supplied once daily in the ponds of T_2 and T_3 on tray placed near the bottom. All uneaten feeds were removed daily from the tray manually. The proximate compositions of local feed and commercial feed are shown in Tables 1 and 2, respectively.

Table 1. Proximate composition of local feed

Ingredients	Percentage (%)	Protein %
Rice bran	70	3.33
Mustard oil cake	30	13.65
Total	100	16.98

Source: BFRI

Table 2. Proximate composition of commercial feed (Saudi-Bangla Shrimp Nursery feed)

Food value	Percentage (%)
Moisture	11
Protein	30
Fat	4
Fiber	6
Ash	17
Carbohydrate	32

Source: Saudi-Bangla fish feed Ltd.

Throughout the experimental period, the water quality parameters were recorded weekly. Temperature (^{0}C), transparency (cm) and dissolved oxygen (mg/l) were measured between 7.00 and 8.00 am daily at the pond site. Alkalinity (m/l), pH and ammonia-nitrogen (mg/l) were measured weekly at Water Quality and Pond Dynamics Laboratory of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh. Temperature and dissolved O_2 were measured by a digital DO meter (YSI model 58). Transparency was measured by using a secchi disc and pH with a pH electrode (Jenway, model 3020). Total alkalinity was determined titrimatrically. Ammonia-nitrogen (NH_3-N) was determined by HACH Kit (DR/2010 spectrophotometer). The chemical reagents used for this purpose were Nesslar reagent, mineral stabilizer and tri-methyl alcohol.

A good number of prawns PL (10-20 individuals) were sampled from each pond at every ten days interval and their length and weight of each individual was measured separately to assess the growth rate of prawns PL. At the end of the experiment, water was pumped out of the ponds and all prawn juveniles were collected, counted and weighed individually for each pond to assess the survival rate. Experimental data was collected and analyzed as follows:

a) Weight gain (g):

Weight gain = Mean final prawn weight − Mean initial prawn weight

b) Average daily gain (g):

$$ADG\ (g) = \frac{\text{Mean final prawn weight} - \text{Mean initial prawn weight}}{T_2 - T_1}$$

c) Specific growth rate (% day)

$$SGR\ (\%\ day) = \frac{Log_e W_2 - Log_e W_1}{T_2 - T_1} \times 100$$

Where,

W_1 = The initial live body weight (g) at time T_1 (day)

W_2 = The final live body weight (g) at time T_2 (day)

d) Survival rate = $\frac{\text{No. of prawn harvested}}{\text{No. of prawn stocked}} \times 100$

For the statistical analysis of the data, a one-way ANOVA and DMRT were done by using the SPSS (Statistical Package for Social Science) version-10.0. Significance was assigned at the 0.05% level. Duncan's test was used to tests the results of multiple ranges for comparisons of averages.

Results

The values of water quality parameters recorded from the experimental ponds during the study period are shown in Table 3. The average value of water temperature in T_1, T_2 and T_3 was 30.6±0.67 ^{0}C, 30.6±0.59 ^{0}C and 30.5±0.56 ^{0}C, respectively; transparency was 41.0±3.84 cm, 41.6±4.72 cm and 42.7±4.63 cm in T_1, T_2 and T_3, respectively; pH in T_1, T_2 and T_3 was 8.03±0.31, 7.89±0.25, and 7.81±0.23, respectively. Dissolved oxygen concentration recorded in T_1, T_2 and T_3, were 3.9±0.37 mg/l, 3.9±0.36 mg/l and 3.7±0.38 mg/l, respectively; total alkalinity in T_1, T_2 and T_3 were 118.7±5.58 mg/l, 126.3±5.46 m/l and 138.3±4.23 mg/l, respectively while the corresponding mean values of NH_3-N were 0.13±0.083 mg/l, 0.11±0.077 mg/l and 0.11±0.075 mg/l in T_1, T_2 and T_3, respectively. There was a significant difference ($p<0.05$) in some water quality parameters like pH and total alkalinity, but all other measured water quality parameters were within the acceptable range for nursing of prawn PL.

Table 3. Water quality parameters of different ponds (Mean ± SD)

Parameters	T_1	T_2	T_3	ANOVA
Temperature (^{0}C)	30.6 ± 0.67	30.6 ± 0.59	30.5 ± 0.56	NS
Secchi disc (cm)	41.0 ± 3.84	41.6 ± 4.72	42.7 ± 4.63	NS
pH	8.0^b	7.9^{ab}	7.8^a	*
DO (mg/l)	3.9 ± 0.37	3.9 ± 0.36	3.7 ± 0.38	NS
Alkalinity (mg/l)	118.7 ± 28.9^a	126.3 ± 28.4^{ab}	138.3 ± 21.9^b	*
Ammonia-N(mg/l)	0.13 ± 0.08	0.11 ± 0.08	0.11 ± 0.07	NS

* $p < 0.05$; NS, not significant

a, b and ab, superscript; Means with different superscripts are significantly *different* ($p < 0.05$)

The survival and growth of prawn PL as obtained from the different treatments are shown in Table 4. The initial mean lengths (cm) were 0.89± 0.008 cm, 0.88±0.01 cm and 0.87±0.03 cm in treatments T_1, T_2 and T_3, respectively; mean initial weights (g) were 0.022±0.00 g, 0.021±0.00 g and 0.022 ±0.002 g in treatment T_1, T_2 and T_3, respectively. At harvest, the mean final length gained by prawn post-larvae were 6.3±0.07 cm, 7.12±0.22 cm and 8.17± 0.16 cm in T_1, T_2 and T_3, respectively and the mean final weight gained by prawn post-larvae were 1.86±0.12, 3.14±0.33 and 4.26±0.44 g in T_1, T_2 and T_3, respectively. The variations in weight gain of prawn PL among the different treatments are shown in Fig.1. Average daily weight gains were 0.031±0.002 g, 0.052±0.006 g and 0.071±0.007 g in treatment T_1, T_2 and T_3, respectively. The specific growth rate (weight) obtained by prawn PLs were 7.42±0.11% per day, 8.35±0.022% per day and 8.81±0.26% per day in T_1, T_2 and T_3, respectively. Survival rates observed in T_1, T_2 and T_3 were 53.86±2.71% (only fertilizers), 60.52±1.64% (fertilizers with 5% local feed) and 66.24±1.58% (10% commercial feed), respectively. Significantly higher ($p<0.05$) growth performance and survival rate were observed in T_3 than T_2 and T_1.

Table 4. Growth performances of prawn larvae in different treatments (Mean ± SD)

Parameters	T_1	T_2	T_3	ANOVA
Initial length (cm)	0.89 ± 0.01	0.88 ± 0.01	0.87 ± 0.03	NS
Initial weight (g)	0.022 ± 0.00	0.021 ± 0.00	0.022 ± 0.002	NS
Final length (cm)	6.3 ± 0.07^a	7.12 ± 0.22^b	8.17 ± 0.16^c	*
Final weight (g)	1.86 ± 0.12^a	3.14 ± 0.33^b	4.26 ± 0.44^c	*
Av. daily gain (g)	0.031 ± 0.002^a	0.052 ± 0.006^b	0.071 ± 0.007^c	*
SGR (% per day)	7.42 ± 0.11^a	8.35 ± 0.22^b	8.81 ± 0.26^c	*
Survival rate (%)	53.86 ± 2.71^a	60.52 ± 1.64^b	66.24 ± 1.58^c	*

* $P < 0.05$; NS - not significant; SGR - Specific growth rate

Means with different superscripts are significantly different ($p < 0.05$)

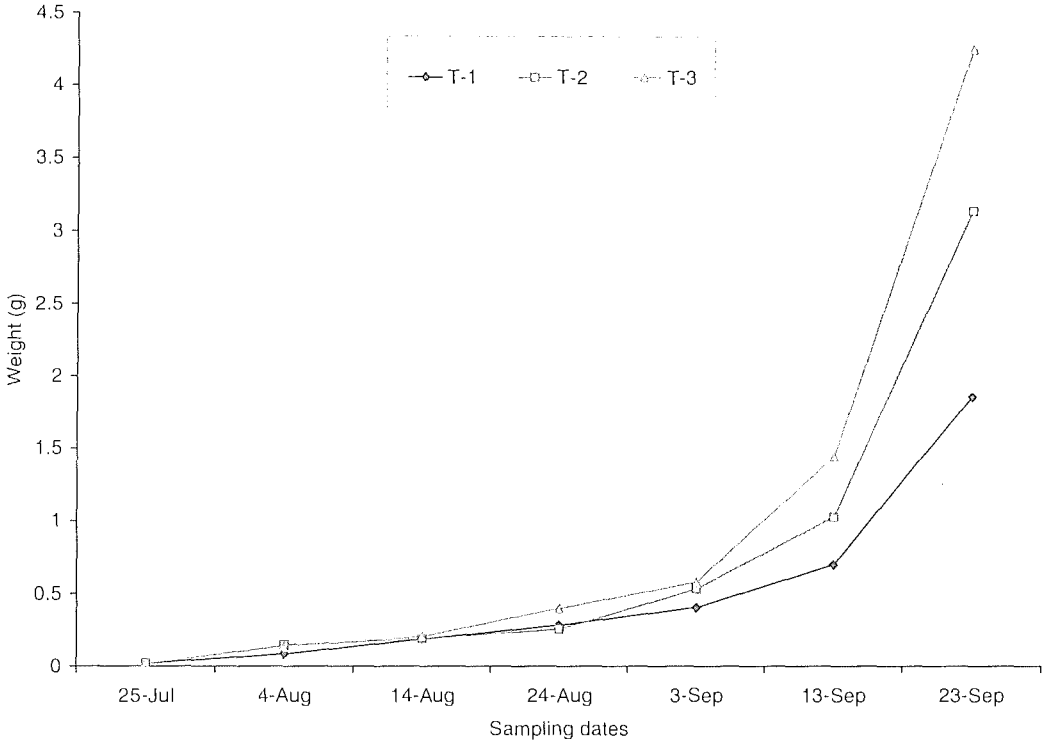

Fig. 1. Variations in weight gain of prawn PL among different treatments

Discussion

Water temperature in this experiment was found to vary from 28.9^{0}C to 31.6 ^{0}C over the entire period. The suitable temperature for nursing of prawn post-larvae was 27-31^{0}C (Fujimura 1974). However, the best growth of post-larvae at the temperature of 28^{0}C (Kneale and Wang 1979). Hoq *et al.* (1996) recorded that water temperature ranged from 27.5 to 30.5 ^{0}C was suitable for the growth of freshwater prawn. The water transparency was found from 32 to 51cm, which was more or less similar to the study of Latif *et al.* (1986), Azim *et al.* (1995). Wahab *et al.* (1995) reported that the transparency of productive water bodies should be 40 cm or less. and having the range from 2.2 to 6.5 mg/l, which was more or less similar to the study of the Hasan (1998), Paul (1998) and Mollah and Haque (1978) for the BAU campus ponds, Mymensingh. Wulff (1982) reported that juveniles of freshwater prawn could tolerate minimum oxygen levels of 1.0 to 1.5 mg/l and suggested not to allow the prawns at such levels for long time. Boyd and Zimmermann (2000) observed that the ideal environment for nursing of prawn post-larvae should have alkalinity of 20-60 mg/l.

pH values varied from 6.83 to 9.43 which were more or less similar to the findings of Jia-Mo *et al.* (1988), Hoq *et al.* (1996) and Hossain *et al.* (2000). According to Wickins (1976), the post-larvae of prawn could endure (without stress) total NH_3-N concentration of approximately 1.00 mg/l for some times. Straus *et al.* (1991) reported

that prawn juveniles should not be exposed to NH_3-N concentration higher than 1 mg/l or 2 mg/l at pH values of 9 and 8.5, respectively for a long period.

The authors *viz.* Sandifer and Smith (1975), Smith and Sandifer (1979), Kneale and Wang (1979), Shaha *et al.* (1989) have shown that prawn PL stocked at the rates between 100-700/m^2 for 45-60 days of nursery system resulted in final survival rates of 60-80%. Though Smith *et al.* (1983) reported that about 90% survival of prawn PL at stocking densities of 1000-1500/m^2 in an enclosed nursery system, only 28-37% survival has been reported by Angell (1994), for nearly same range of stocking density, in a case nursery system in Bangladesh condition. Chi and Oanh (1988) found that the survival rates of prawn post-larvae stocked at 10, 15 and 20 PL/m^2 were 56.1, 54.1 and 47.7% after 90 days, respectively. Nursery rearing of *M. rosenbergii* post-larvae in earthen ponds is limited (Williams and Berrigan 1977). Though Saha *et al.* (1989) reported 52% survival at the stocking density of 175 PL/m^2 in 30 days of rearing in earthen ponds and a mean final weight of 1-2 g after 40-90 days may be achieved in earthen pond nursery. The results in growth performances of *M. rosenbergi* in the present study more or less agreed with the above studies and it was clearly observed that the growth and survival of *M. rosenbergii* post-larvae were better in fed ponds where 30% protein rich commercial feed was supplied. Therefore, it may be recommended to the nursery that protein rich feed is a prerequisite for achieving success in nursery operations.

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